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<p>(21) International Application Number: <b>PCT/GB96/00371</b></p> <p>(22) International Filing Date: <b>19 February 1996 (19.02.96)</b></p> <p>(30) Priority Data: 95/01860                    17 February 1995 (17.02.95)                    FR</p> <p>(71) Applicant (<i>for all designated States except US</i>): <b>HOLSET ENGINEERING CO. LTD. [GB/GB]; St Andrews Road, Huddersfield HD1 6RA (GB).</b></p> <p>(72) Inventor; and (75) Inventor/Applicant (<i>for US only</i>): <b>RIU, Hervé [FR/FR]; 14, Le Petit Bois, F-38140 La Murette (FR).</b></p> <p>(74) Agent: <b>EVERY, David, Aidan; Marks &amp; Clerk, Sussex House, 83-85 Mosley Street, Manchester M2 3LG (GB).</b></p>		<p>(81) Designated States: <b>AL, AM, AT, AU, AZ, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IS, JP, KE, KG, KP, KR, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).</b></p> <p><b>Published</b>  <i>With international search report.</i>  <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i></p>	
<p><b>(54) Title:</b> <b>DRIVE DEVICES</b></p> <p><b>(57) Abstract</b></p> <p>Device for driving at least one piece of equipment, from a driving shaft, having a torsional vibration damper. This device comprises a primary element (11) intended to be fixed to the driving shaft and a secondary element (21) intended to be connected to the piece of equipment; the primary element (11) is linked, on the one hand, to an inertia ring (15) via first elastic means (14) and, on the other hand, to the secondary element (21) via second elastic means (24); in operation, the relative rotational displacement, when there is any, between the secondary element (21) and the inertia ring (15) is a relative displacement with friction.</p>			
<p>The diagram illustrates a cross-section of a drive device. It features a central vertical shaft. At the top, a primary element (11) is secured to the shaft. A secondary element (21) is attached to the shaft below the primary element. An inertia ring (15) is positioned around the shaft, connected to the primary element (11) by first elastic means (14). The secondary element (21) is connected to the shaft by second elastic means (24). The assembly includes various mechanical parts such as bearings, housings, and a central housing section labeled with numbers like 13, 14, 16, 17, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, and 50.</p>			

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## **DRIVE DEVICES**

**The present invention relates to drive devices having torsional vibration dampers.**

**More particularly, the present invention relates to devices for driving at least one piece of equipment, from a driving shaft, having a torsional vibration damper for rotating masses, which devices comprise a primary element intended to be fixed to the driving shaft and a secondary element intended to be connected to the said at least one piece of equipment, the said primary element being linked, on the one hand, to an inertia ring via first elastic means and, on the other hand, to the secondary element via second elastic means.**

**Such drive devices are well known; they are, for example, mounted at the end of the driving shaft of a motor vehicle and permit the rotational driving of one or (more) piece(s) of equipment, such as an alternator, a fan or another piece of equipment. A device of this kind is described, for example, in the document DE-A-4322710.**

**Such a drive device is provided so that two main functions are fulfilled, namely a damping function and a filtering function.**

**The damping function dampens the torsional vibrations of the driving shaft, for example the crankshaft of the engine of the vehicle, thanks to the association of the inertia ring and the first elastic means, the properties of which, inertia and elasticity, are determined as a function of the dynamic characteristics of the driving shaft and the moving equipment linked to it.**

**The filtering function filters the cyclic irregularities of the driving shaft; in the case of a motor-vehicle engine, it is known that these irregularities appear at low speed and that they impair the correct operation of the engine and the mechanical stability of the pieces of equipment driven by the device; this filtering function is fulfilled by the second elastic means which are chosen to have great torsional flexibility, which is calculated while taking into account the pieces of equipment driven by the device.**

Such drive devices work well but, as indicated, their structure and therefore their space requirement is dependent, on the one hand, on the driving component, and even [sic] the driving shaft and the moving equipment linked to it, and, on the other hand, on the piece(s) of equipment which is (or are) driven; it is not always possible therefore, for a given application, to dimension them strictly in accordance with the calculations, which therefore impairs the efficiency and the mechanical stability of the components concerned.

The object of the present invention is to overcome these disadvantages and its subject is a drive device which can be adapted rigorously, whatever the application.

According to the invention, a device for driving at least one piece of equipment, from a driving shaft, having a torsional vibration damper for rotating masses, which device comprises a primary element intended to be fixed to the driving shaft and a secondary element intended to be connected to the said at least one piece of equipment, the said primary element being linked, on the one hand, to an inertia ring via first elastic means and, on the other hand, to the secondary element via second elastic means, is characterised in that, in operation, the relative rotational displacement, when there is any, between the secondary element and the inertia ring is a relative displacement with friction.

Thanks to this arrangement, these friction means add their action to those of the inertia ring and the elastic element and it is thus possible, by combining these various actions, to find, for a given space requirement, the drive device which is perfectly suited.

Advantageously, friction means are provided between the secondary element and the inertia ring.

According to a preferred embodiment, the secondary element has a rim extending parallel to the axis of the device and the said rim at least partly covers the inertia ring, which has a cylindrical outer face facing the said rim, the friction means being placed between the said rim and the said cylindrical outer face of the

inertia ring; advantageously, the friction means are in the form of a cylindrical ring, thus constituting a radial guide bearing.

A drive device in which the secondary element has a rim at least partly covering a cylindrical outer face of the inertia ring is known; this is the case, for example, of the device described in the document already cited above, in which there are no friction means, a bearing in the form of a ball bearing being arranged between the primary element and the secondary element; this is also the case of the device according to the document EP-A-0 667 468, which has a filing date earlier than the filing date of the present application but was published after the filing date of the present application, in which device there are likewise no friction means, a plain bearing without friction being arranged between the secondary element and the inertia ring, this plain bearing being composed of a rubber-like elastic material in which are incorporated particles which reduce wear and stabilise the shape.

Preferably, in the drive device according to the present invention, the said rim is a pulley rim for driving the said at least one piece of equipment by means of a belt.

Advantageously, the primary element is in the general form of a drum of revolution comprising a transverse disc and an axial cylindrical ring which are connected by a slightly conical skirt, the first elastic means being arranged between the said ring and the inertia ring.

Preferably, the second elastic means are placed between a transverse covering of the secondary element and an annular bearing surface of a counter-covering fixed to the primary element.

Advantageously, the second elastic means are prestressed; the prestress is axial; the axial prestress is ensured by a transverse support covering of a support element fixed to the primary element; the support covering is placed opposite the transverse covering of the secondary element; an axial stop element is arranged between the said support covering and the said transverse covering.

Preferably, limiting means are provided for limiting the angular travel of the secondary element with respect to the primary element; the said limiting means comprise at least one nose, carried by the transverse covering of the secondary element, extending axially into an opening formed in the support covering of the support element.

A further subject of the invention is a device for driving at least one piece of equipment, from a driving shaft, having a torsional vibration damper for rotating masses, which device comprises a primary element intended to be fixed to the driving shaft and a secondary element intended to be connected to the said at least one piece of equipment, the said primary element being linked, on the one hand, to an inertia ring via first elastic means and, on the other hand, to the secondary element via second elastic means, in which, in operation, the relative rotational displacement, when there is any, between the secondary element and the inertia ring is a relative displacement with friction, friction means being provided between the secondary element and the inertia ring, the secondary element having a rim extending parallel to the axis of the device and at least partly covering the inertia ring, which has a cylindrical outer face facing the said rim, the friction means being placed between the said rim and the said cylindrical outer face of the inertia ring, the friction means being in the form of a cylindrical ring, thus constituting a radial guide bearing.

Preferably, in such a device the second elastic means are placed between a transverse covering of the secondary element and an annular bearing surface of a counter-covering fixed to the primary element, the second elastic means being prestressed axially by a transverse support covering of a support element fixed to the primary element, the support covering being placed opposite the transverse covering of the secondary element, an axial stop element being arranged between the said support covering and the said transverse covering, limiting means, comprising at least one nose, carried by the transverse covering of the secondary element, extending axially into an opening formed in the support covering of the

**support element, being provided for limiting the angular travel of the secondary element with respect to the primary element.**

The invention will be better described with reference to the attached drawings in which:

- Figure 1 is a sectional view of a drive device according to the invention;
- Figure 2 is a partial view from the left, with respect to Figure 1, of the device according to Figure 1.

Referring to Figure 1, a drive device 10 will be seen which comprises a primary element 11 intended to be fixed to a driving shaft, for example the shaft of the engine of a motor vehicle, and a secondary element 21 intended to be connected to a piece of equipment, for example a piece of equipment of the said vehicle, such as an alternator, a fan or another piece of equipment, for driving the said piece of equipment by the said driving shaft.

The primary element 11 is formed, according to the example shown, of a disc 16 provided with holes 18 for fastening it by screwing to a flange, not shown, placed at the end of the driving shaft. The disc 16 carries, via a connecting skirt 12 of slightly conical shape, a ring 13 of revolution extending parallel to the axis 20 of the device 10, which axis 20 coincides with the axis of rotation of the driving shaft.

An inertia ring 15 surrounds the ring 13, to which it is fixed via an elastic element 14 mounted in compression between the inertia ring 15 and the ring 13: such an assembly, as known per se, constitutes a damper for damping the torsional vibrations of the driving shaft, the inertia of the ring 15 and the elastic properties of the elastic element 14, often made of elastomer, being adapted, of course, to the dynamic characteristics of the driving shaft and, in particular when the driving shaft is the shaft of the engine of a vehicle, to all the moving equipment of the engine linked to it.

The inertia ring 15 has a cylindrical outer face 17, whose role will become apparent below, which is limited on one side by a collar 19, of larger diameter, which belongs to the inertia ring 15 and which permits, in particular, the balancing of the said inertia ring 15 by conventional material-removal methods.

The secondary element 21 is formed of a transverse covering 23 to which a pulley rim 22 is connected. The covering 23 of the secondary element 21 is connected to an elastic ring 24, itself fixed to the primary element 11; more precisely, instead of linking the elastic ring 24 directly to the primary element 11, it is preferred to link it to a flared annular bearing surface 25 of a disc 26, itself rotationally fixed to the disc 16 of the primary element 11: thanks to this arrangement, the secondary element 21 comprising the covering 23 and the pulley rim 22, the elastic ring 24 and the disc 26 constitute a subassembly which can be adapted to the particular application in question; advantageously, the flared annular bearing surface 25 exactly follows the slightly conical shape of the skirt 12 of the primary element 11.

The pulley rim 22 at least partly covers the inertia ring 15: more precisely, the cylindrical outer face 17 of the inertia ring 15 faces the pulley rim 22; friction means are placed in the gap thus defined between the cylindrical outer face 17 of the inertia ring 15 and the pulley rim 22; these friction means are constructed in the form of a cylindrical ring 40 so that they constitute, furthermore, a radial guide bearing for the pulley rim 22; these friction means add their action to those of the inertia ring 15 and the elastic element 14, that is to say they provide additional damping, through friction, which improves the vibratory attenuation of the natural torsional mode of the driving shaft; thanks to this arrangement, it is also possible, for a given space requirement which is too restricted to receive an inertia ring and/or an elastic element which are/is correctly dimensioned, to compensate for the restrictedness of the space requirement using these friction means.

The role of the elastic ring 24 is to filter the cyclic irregularities of the driving shaft by preventing their transmission to the pieces of equipment via the belt driven by the pulley rim 22; to do this, the elastic ring 24 exhibits great torsional flexibility; it is advantageous, as is known, to mount the elastic ring 24 in an axially stressed manner, so as to reduce the stresses in the material during the active working phase; to this end, a support element 31 is provided; this support element 31 has a support covering 33 placed externally opposite the covering 23 of

the secondary element 21; the support covering 33 is connected to a disc 36 by a connecting cone 32; the disc 36 is fixed to the primary element 11; thus, the discs 16, 26, 36 are fixed to one another; this may be obtained by weld points and/or by screwing the three discs onto the flange at the end of the driving shaft, the discs 26 and 36 having holes 28 and 35, respectively, placed in line with the holes 18 of the disc 16 to constitute passages 30 for fastening screws.

An axial stop 50 placed between the covering 23 of the secondary element 21 and the support covering 33 of the support element 31 facilitates the relative circumferential displacement between the covering 23 and the support covering 33, which relative displacement is damped by the elastic ring 24 mounted in axial compression.

Since the elastic ring 24 has great torsional flexibility, it is advantageous to limit the relative circumferential travel between the primary element 11 and the secondary element 21, that is to say between the covering 23 and the support covering 33: to this end, the covering 23 has noses 27, for example three noses 27 spaced regularly circumferentially, which extend, in accordance with the axis 20, into an opening 34 formed in the support covering 33.

The axial positioning of the covering 23, with respect to the end of the driving shaft, obtained by the support covering 33 via the axial stop 50, permits, furthermore, correct positioning of the grooves or ridges of the pulley rim 22.

As has been shown, the drive device according to the invention is of simple and economical construction; it has a torsional vibration damper performing the two main functions, damping and filtering, in a compact assembly having a small number of components.

Of course, the present invention is not restricted to the embodiment described and shown but includes any alternative embodiments.

**CLAIMS**

- 1. Device for driving at least one piece of equipment, from a driving shaft, having a torsional vibration damper for rotating masses, which device comprises a primary element (11) intended to be fixed to the driving shaft and a secondary element (21) intended to be connected to the said at least one piece of equipment, the said primary element (11) being linked, on the one hand, to an inertia ring (15) via first elastic means (14) and, on the other hand, to the secondary element (21) via second elastic means (24), characterised in that, in operation, the relative rotational displacement, when there is any, between the secondary element (21) and the inertia ring (15) is a relative displacement with friction.**
- 2. Device according to Claim 1, characterised in that friction means are provided between the secondary element (21) and the inertia ring (15).**
- 3. Device according to Claim 2, in which the secondary element (21) has a rim (22) extending parallel to the axis (20) of the device, characterised in that the said rim (22) at least partly covers the inertia ring (15), which has a cylindrical outer face (17) facing the said rim (22), the friction means being placed between the said rim (22) and the said cylindrical outer face (17) of the inertia ring (15).**
- 4. Device according to Claim 3, characterised in that the friction means are in the form of a cylindrical ring (40), thus constituting a radial guide bearing.**
- 5. Device according to one of Claims 2 or 3, characterised in that the said rim (22) is a pulley rim for driving the said at least one piece of equipment by means of a belt.**
- 6. Device according to one of Claims 1 to 5, characterised in that the primary element (11) is in the general form of a drum of revolution comprising a transverse disc (16) and an axial cylindrical ring (13) which are connected by a slightly conical skirt (12), the first elastic means (14) being arranged between the said ring (13) and the inertia ring (15).**
- 7. Device according to one of Claims 1 to 6, characterised in that the second elastic means (24) are placed between a transverse covering (23) of the secondary**

element (21) and an annular bearing surface (25) of a counter-covering (29) fixed to the primary element (11).

**8. Device according to one of Claims 1 to 7, characterised in that the second elastic means (24) are prestressed.**

**9. Device according to Claims 7 and 8, characterised in that the prestress is axial.**

**10. Device according to Claim 9, characterised in that the axial prestress is ensured by a transverse support covering (33) of a support element (31) fixed to the primary element (11).**

**11. Device according to Claim 10, characterised in that the support covering (33) is placed opposite the transverse covering (23) of the secondary element (21).**

**12. Device according to Claim 11, characterised in that an axial stop element (50) is arranged between the said support covering (33) and the said transverse covering (23).**

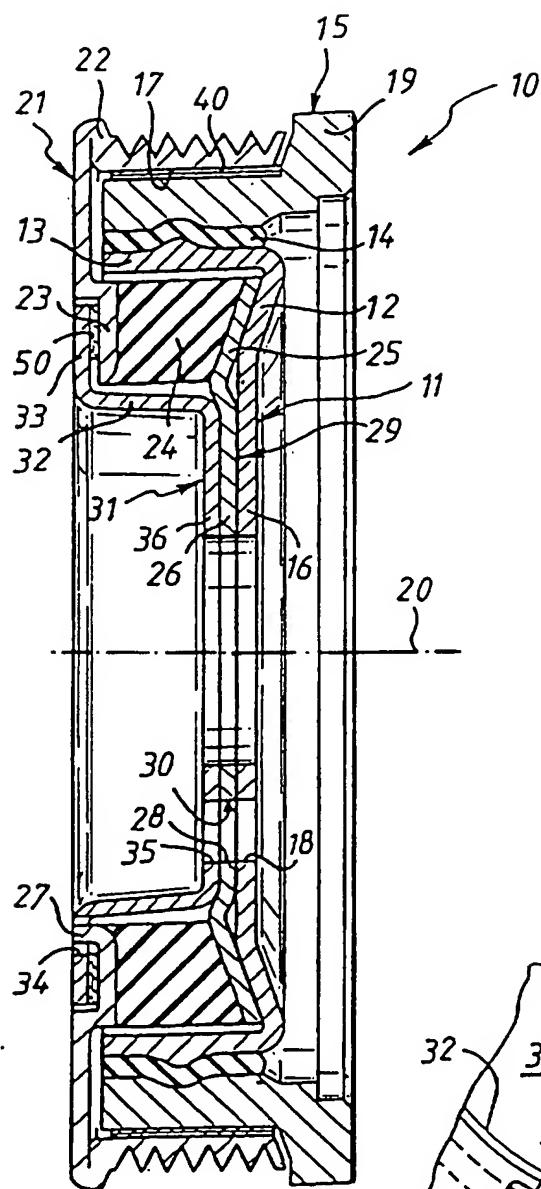
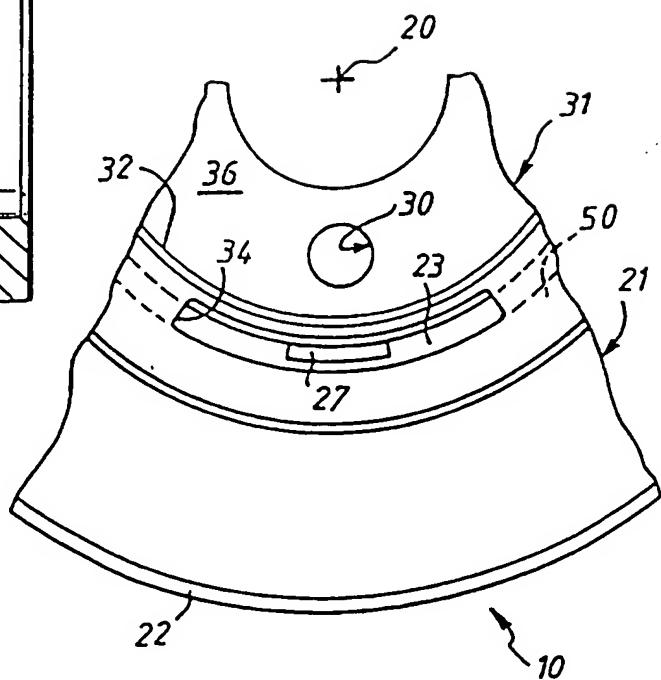
**13. Device according to one of Claims 1 to 12, characterised in that limiting means are provided for limiting the angular travel of the secondary element (21) with respect to the primary element (11).**

**14. Device according to Claims 11 to 13, characterised in that the said limiting means comprise at least one nose (27), carried by the transverse covering (23) of the secondary element (21), extending axially into an opening (34) formed in the support covering (33) of the support element (31).**

**15. Device for driving at least one piece of equipment, from a driving shaft, having a torsional vibration damper for rotating masses, which device comprises a primary element (11) intended to be fixed to the driving shaft and a secondary element (21) intended to be connected to the said at least one piece of equipment, the said primary element (11) being linked, on the one hand, to an inertia ring (15) via first elastic means (14) and, on the other hand, to the secondary element (21) via second elastic means (24), characterised in that, in operation, the relative rotational displacement, when there is any, between the secondary element (21) and the inertia ring (15) is a relative displacement with friction, friction means**

being provided between the secondary element (21) and the inertia ring (15), the secondary element (21) having a rim (22) extending parallel to the axis (20) of the device and at least partly covering the inertia ring (15), which has a cylindrical outer face (17) facing the said rim (22), the friction means being placed between the said rim (22) and the said cylindrical outer face (17) of the inertia ring (15), the friction means being in the form of a cylindrical ring (40), thus constituting a radial guide bearing.

16. Device according to Claim 15, characterised in that the second elastic means (24) are placed between a transverse covering (23) of the secondary element (21) and an annular bearing surface (25) of a counter-covering (29) fixed to the primary element (11), the second elastic means (24) being prestressed axially by a transverse support covering (33) of a support element (31) fixed to the primary element (11), the support covering (33) being placed opposite the transverse covering (23) of the secondary element (21), an axial stop element (50) being arranged between the said support covering (33) and the said transverse covering (23), limiting means, comprising at least one nose (27), carried by the transverse covering (23) of the secondary element (21), extending axially into an opening (34) formed in the support covering (33) of the support element (31), being provided for limiting the angular travel of the secondary element (21) with respect to the primary element (11).

1 — 1FIG . 1FIG . 2

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 96/00371

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 F16H55/14 F16H55/36 F16F15/126 F16F15/129

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## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 F16H F16F F16D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	DE,C,44 04 311 (FREUDENBERG CARL FA) 13 April 1995	1,6
A	see the whole document	2-5,7, 15,16
Y	---	
A	DE,A,43 22 710 (PAHL GUMMI ASBEST) 12 January 1995 cited in the application	1,2
A	see the whole document	3,5-7, 15,16
Y	---	
A	GB,A,896 548 (SCHWITZER) 16 May 1962 see figures 1,2	1,2 5,6,15
A	---	
A	DE,A,31 07 371 (BAYERISCHE MOTOREN WERKE AG) 16 September 1982 see abstract; figure 2	1-3,5, 7-12,15, 16
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4 Date of the actual completion of the international search

10 June 1996

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## C(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE,A,44 20 178 (LUK LAMELLEN & KUPPLUNGSBAU) 22 December 1994 see figure 1 ---	1,3, 5-10,15, 16
A	EP,A,0 012 669 (CITROEN SA ;PEUGEOT (FR)) 25 June 1980 see ; figure 1 -----	1,5,15

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Information on patent family members

International Application No

PCT/GB 96/00371

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GB-A-896548		US-A-	3078737	26-02-63
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DE-A-4420178	22-12-94	NONE		
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